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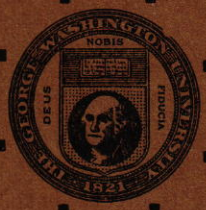

THE GEORGE WASHINGTON UNIVERSITY
SCHOOL OF ENGINEERING

- ★ ASME 69TH ANNUAL MEETING
- ★ HIGH SPEED RADIO-TELETYPE
- ★ A SUGGESTED COURSE FOR COMMUNICATIONS ENGINEERING
- ★ LIGHT POWER
- ★ ELECTRO MAGNETIC FLUID CLUTCH

JANUARY 1949

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The ASME 69th Annual Meeting

By ALEXANDER LEVIN

The 69th Annual Meeting of the American Society of Mechanical Engineers was held at the Hotel Pennsylvania in New York, Nov. 28-Dec. 3, 1948.

The School of Engineering was well represented. Professors Cruickshanks, Trumbull, Greeley and Kohloss attended on the 1st and 2nd of December, and yours truly performed the feat of student representative during the same period.

Thousands of members from all over the country gathered together to discuss the affairs of the society and to attend more than 70 technical sessions, at which over 200 technical papers were presented. In addition to these sessions the program was filled with numerous luncheons and dinners. Topping the list of these events were the Annual Banquet and Honor Night and the Members and Students Luncheon.

The large variety of technical material presented at the meeting covered the latest developments and research in the field of mechanical engineering, and covered the fields of hydraulics, applied mechanics, production engineering, heat transfer, machine design, management, lubrication and petroleum, education, industrial instruments, oil and gas power, materials handling, metals engineering, railroads, markets, aviation, and plastics and textiles.

Because of the extent of the program, it is possible in this account to touch only the highlights. In the brief summaries which follow, an attempt has been made to record some general impressions of events in two days of the Annual Meeting.

The Oil and Gas Power Division of ASME sponsored a variety of papers concerned with combustion phenomena, exhaust energy in the

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High Speed Radioteletype

By GRAHAM SCHOFIELD

The industrial expansion of our country has resulted from the desire of manufacturers to find ways and means of increasing the reliability of their product and of increasing the rate of production along with decreasing the unit cost. The rise to prominence of Radio-teletype as a means of point-to-point communication follows generally along those lines in that during the war, a method of communication was required which would give a fast, reliable means of transmitting intelligence from one service command to another. With an authentic copy of the message transmitted and received.

As a matter of background, a discussion of the main types of point-to-point communication will be made. The first main type is that of Manual Operation. At the transmitting end of the circuit, the messages are sent out by a man who is either operating a hand key of some form or is feeding a punched tape through an automatic keying head. The signal is received by the radio operator at the distant point who records the message. Since perception of the signal by the receiving operator is necessary, there is a limit to the speed at which the intelligence may be transmitted. Due to physiological differences in human beings, all men cannot interpret the code signals equally well in regard to speed of transmission. The Navy set a minimum requirement for its radio operators such that men of Petty Officer rating must be able to copy 18 words per minute code groups and 22 words per minute plain language. Navy shore stations transmitting messages to ships at sea varied in speed of transmission of from 16 to 22 words per minute.

The second main type of point-to-point communication falls into the classification of semi-automatic operation. The sending operator feeds a tape into a keying head or some other form of automatic sending device. The signal is received at the distant point and recorded by automatic means. An ink recorder is an example of this automatic reception. Operators at the receiving end transcribe the inked tape. It can be seen, when comparing this means of communication to Manual operation, that emphasis has been shifted from the ear to the eye and in doing so, increased transmission speed is achieved.

The third main type of point-to-point communication is that of fully automatic operation or Radioteletype. Printing telegraphy goes one step further in removing the human element from the process of receiving and this is accomplished by substituting a mechanism which is impelled

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A SUGGESTED COURSE FOR COMMUNICATIONS

By N. C. HEKIMIAN

Those in Communications Engineering have witnessed in their stay one sweeping change in the Communications curriculum towards the end of formulating an up-to-date, coherent course of study. It is the object of this paper to suggest not another broad change but rather an addition that will further aid in achieving a better course of study.

At present the junior and senior years see the student actually commencing study in his major, the first two years being rather general. These two last years form a Communications Engineer with the advantages of background and thorough understanding over the technical school graduates. The sad fact, though, is that many graduates under the present curriculum will be entering their profession with less know-how than most graduates from twelve- and eighteen-month courses. Many will have never constructed a working piece of equipment by themselves! Yet these men are expected to grasp quickly and ably any job thrust upon them after graduation. It should be an axiom that a poor engineer is no engineer at all!

The student should not be left to gather unto him smatterings of practical know-how but given suitable guidance and credit for his work. This paper proposes a course constructed to give maximum convenience, individuality in work and simultaneously providing a means of obtaining practical experience.

The course will incorporate an extensive number of part-term projects in line with the individual student's particular desires. To foster a desire to do the best, on the part of the student, each project may carry a maximum number of credits on the basis of the subjects of the project. The actual credit received on each project will be determined by grading of first, a written report on the project; second, quality of the project; proportionate time required to complete the project could be a third item.

In a manner to allow most convenience, the hours for each student could be arranged, or as an alternative certain "open" laboratory periods could be allocated, in preference to preordained class hours. The latter in a project course would be senseless. Work will be strictly individual with no group work, unless by the instructor's permission on large project.

Equipment, parts, etc., could be supplied for small quantities out of a laboratory fee, or by purchase. Apparatus built with school equipment exclusively would remain school property while that built with only expendible parts supplied by the school may remain the property of the student. Construction will be of a permanent type rather than open or "breadboard" style.

Upon commencing the course the student will select a project and record it with the instructor. The student will then proceed to design the apparatus and construct it according to his design. At the completion of construction and preliminary testing, operational tests will be made and performance characteristics will be determined.

For indoctrination of those students completely unfamiliar with construction techniques there would be a few organized class meetings immediately at the beginning of the course each term it is offered. These meetings will emphasize wiring, layout, selection of components, commercial standards, and care and use of tools and equipment. There should be no necessity for instruction in theory since the student is at liberty to select a project which he deems himself capable of handling.

After the design is completed it should be checked by the instructor for gross errors but not with the idea of improving the design. The report submitted prior to the actual construction will consist of a complete circuit diagram, calculations, and mention of anticipated results.

The maintenance of a college level in the course relies upon the written report, to the greatest extent. It may be said that the report is the crux of the course. The report insures that each project is entirely developed by the student by including *absolutely all* of the calculations involved in the design of the equipment and predictions of performance and discussion of actual performance. Included in the report will be (1) complete schematic diagrams, (2) a description of intended operation of the unit, (3) performance data and curves, if any, (4) discussion of the actual performance, (5) detailed computations and an explanation of the procedure used. Adherance to this set-up makes it relatively improbable that circuits will be taken from some source and blindly wired in a manner befitting a technician.

A few suggested items for projects could incorporate the following to good advantage. It will be noted that test instruments are prominent among the items. This is done intentionally since it is felt that a thorough knowledge of instruments is essential to the engineer so that he knows the characteristics and limitations of the measuring devices he will rely upon in his work. Should the student wish to keep the apparatus made, he will have possession of at least a few

The holding ability of the Magnetized Iron-oil Mixture that is the heart of the new Magnetic Fluid is demonstrated by this test at the National Bureau of Standards. Jacob Rabinow (dark suit), the inventor, and Louis Schuman, Development Engineer, hold Patricia Hickok (120 pounds); off the ground while the swing in which she is sitting is being held solely by a 2-inch square plate immersed in Iron-In-Oil energized by an electromagnet.

basic instruments—instruments he knows completely. The following are suggested topics: vacuum tube voltmeter, oscilloscope, signal generator, multitester, grid dip meter, reactance bridge, audio amplifier, F. M. tuner, broadcast, etc., receiver, audio oscillator. It should be noted that these are but a minute part of possible projects, with most any degree of complexity possible in each case. Because of these facts establishment of a possible grade should wait upon the submission of the circuit.

The subject of grading brings up a point open to discussion. Previously in the paper all references have been made on the assumption that a "credit" grading system would be used. It should be apparent that such a system is as arbitrary as any other, but at present it seems to be preferable. Another extreme case, would be to have preassigned projects for the entire course. (While such a system in the opinion of this

(*Continued on page 10*)

Christmas Tree Presentation

By BOB SCHOFIELD

Annually for the past ten years, the Engineering school has taken the initiative to present a Christmas tree to the George Washington University. This year the Engineer's Council, through their representative, Don Davis, was responsible for the task of erecting the tree and planning the presentation program.

Many engineering students played an important part in making the venture a success. Much work had to be done before the presentation ceremonies could take place and the men who expended time and effort on the job should receive commendation for their work. The men responsible for bringing the tree down to the Lisner Terrace were Don Davis, Merrill Brown, Ken Brown, Hollis Kushman, and George Titrington. The building of the foundation for the large tree was accomplished through skills of carpentry exhibited by Chuck Appel, Rudy Besier, Bob Surine, and Bob Schofield. The task of righting the tree to a vertical position fell to Scotty Edson, Gerald Summers, Jim Sinsabaugh, and the men previously noted above for their specialized functions. The two men responsible for the stringing of the tree lights were Bill Klein and the popular electron commando, Matt Flato. The balloon, newly-acquired symbol of the engineering school, defied the law of gravity through the efforts of Al Tinkelenberg, Keith Allen, and Wallace Kistler.

With this work accomplished, the Program Committee of Larry Brown, Birch Eakin, and Ben Cruickshanks took charge and made the necessary plans for the presentation ceremonies. The presentation program took place at 5:30 P.M., December 13, 1948. The program opened with several Christmas selections by the George Washington University Glee Club. The glee club soloist, Miss Betty King, thrilled the crowd with her singing of Silent Night and Little Town of Bethlehem. The presentation of the tree to the university was then made by Mr. Frederick M. Feiker, Dean of the School of Engineering. The tree was accepted by Dean H. G. Doyle on behalf of the university. Mr. Doyle, Dean of the Columbian College, had warm words of praise for

(*Continued on page 5*)

ALUMNI

Our problem for the alumni:

> A surveyor was asked by three clients to survey an acre consisting of three lots. Each client owned a rectangular lot and all dimensions were even feet. Mr. Alot said his was a long as Blot's and as wide as Clot's was long. Mr. Blot said his was as wide as Clot's, and Mr. Clot begged the surveyor to make his as big as possible. How big was Clot's lot.

Do you think you can work it?? If you can send the answer and a little news about yourself to the Mecheleciv, George Washington University, Washington, D.C. We would be glad to use your favorite brain teaser in later issues so send them in with answers, of course.

Answer to last issue's problem. The farmer bought 94 chickens for $47.00, 1 pig for $3.00, and 5 cows for $50.00 making a total of 100 animals and $100.00. The first alumnus to send in this correct answer was Don I. Gulbrandson, BSCE-1941. Good work, Don!

Roy F. Carty, BS in ME '11, ME '12. Mr. Carty's father, who was an inventor, stimulated his early interest in things mechanical, an interest that led to his chosen profession. His first job was as a draftsman with the U. S. Patent Office after which he went to the Bureau of Standards. He was in charge of the Bureau of Standards exhibit at the St. Louis Worlds Fair. While working here Mr. Carty attended George Washington University. Upon graduation he accepted a job as engineer with the Inter-state Commerce Commission, a position he left during the first World War to become Chief Purchasing Agent for the U. S. Shipping Board and Emergency Fleet Corps. At this time Mr. Carty started his first business, renting and repairing typewriters at night. His shop was the back of his car. This business soon grew to the point where a partner was needed and the Commercial Typewriter Corp. was founded.

After the war Mr. Carty obtained the franchise for the distribution of Philco Batteries in the Metropolitan Area. To this business were soon added all sorts of auto electrical services and eventually facilities were expanded to completely overhaul and rebuild all types of electrical motors and generators from 1/100 to 100 h.p. in size.

Mr. Carty retired from active business in 1945 and has spent much of his time since then in traveling.

Mr. Carty pointed out that every business grows in cycles and that new items must be constantly added as old ones are discarded, in Mr. Cartys own words: "Anybody can copy, but perseverance in developing new items is an accomplishment that every young engineer should encourage." The greatest business asset is "nerve."

Watson Davis, BS in CE, '18, CE '20 was interested in journalism even before he graduated from George Washington University. During his sophomore and junior years he served as editor of the Hatchet. While working at the Bureau of Standards as an assistant engineer-physicist, Mr. Davis also found time to be science editor for the Washington Herald. In 1921 Mr. Davis became news editor of Science Service, the not-for-profit institution for the popularization of science and he advanced through the years until he became director of this service in 1933. Science Service operates as a news agency in the field of science serving the larger newspapers here and abroad and also publishes the Science News Letter (weekly) and Chemistry (monthly). Mr. Davis is editor of the Science News Letter and coeditor with his wife, Mrs. Helen Miles Davis, of Chemistry.

Mr. Davis is also credited with coining the word microfilm. He has done much research on microphotographic duplication, and has developed methods for making available upon microfilm many documents that could not be published promptly and completely. As president of the American Documentation Institute he has already made significant beginnings on the task of getting literature out of the libraries and onto the desk of research workers.

During a recent address before the Philadelphia Section of the AIEE Mr. Davis made the following statement which could be taken as good advice to our future engineers. "The method of science and technology is the great ethical method. The scientist or engineer who deviates from insistence on freedom and honesty in his search for knowledge or the application of technology is just seeking trouble. No amount of doctrine, no matter how highly sponsored, will cause a deceitfully designed dam to resist the flood. Scientific honesty and freedom is at the heart of the democracy of free people."

A teacher asked her young student who, in his opinion, were the three greatest presidents of the U. S. After a minute's hesitation, he answered —Washington, Roosevelt and Truman.

"Why?" asked the teacher.

"Well, Washington couldn't tell a lie, Roosevelt couldn't tell the truth, and Truman can't tell the difference."

Light Power

By LLOYD HARKER

Although science is not yet positive as to what light is, astounding and useful inventions have been made with the use of the principals of light which have been proved. One of those proven theories is that any radiation, such as a flashlight beam, has a measurable pressure when it is absorbed or reflected by a surface.

An invention which has been developed recently by Dr. Jesse W. Beams of the University of Virginia makes use of this theory. By directing a stream of light directly on a properly designed rotor, he found that he could set the rotor into an ever increasing motion. Dr. Beams found that by directing a beam from a 100-watt lamp on a small rotor, he could start the rotor from rest and attain a speed of 600,000 revolutions per second with it. An electric motor runs at about 1800 revolutions per second by comparison.

The spheres are suspended by magnetic forces in a vacuum, and friction is almost entirely eliminated. When one of the rotors is given a push, it will continue spinning for two years with no additional aid. With no friction the rotor would theoretically spin forever.

Only the strength of the rotor material limits the speed which can be obtained by these rotors. At a speed of 600,000 revolutions per second, even the finest steel is torn to bits by centrifugal force. Dr. Beams hopes to overcome this speed limit by using smaller rotors and stronger material, and to obtain still higher speeds than heretofore. Even now, however, the present rotors vary in weight from only a few ounces to two pounds.

Around any spinning object there is a centrifugal field. Dr. Beams started working on the rotors with the idea of producing extremely high centrifugal fields. Now it appears that since the acceleration of the rotors is due to light pressure alone, he may be able to measure precisely the pressure of light by the relative speeds of the rotors.

For more complete descriptions of the high-speed rotor, look in the Proceedings of the Washington Academy of Sciences, July 1947.

———o———

A pair of newlyweds had tipped the porter generously on boarding the train to keep the fact a secret. The next morning, noticing the many knowing looks cast in their direction, the angry groom called the porter to account for his treachery.

"Lawdy, boss," he replied, "I didn't tell 'em; they asked me if you was just married and I sez 'No, they is jus' very good friends'."

Sigma Tau

The fall semester initiation ceremonies of Sigma Tau were held Saturday afternoon, December 4, 1948 in Studio A of the Lisner Auditorium. These activities were followed by a large banquet at the Roger Smith Hotel in the evening. In addition to the newly initiated men, guests of honor present at the banquet included such familiar personages as Dean Feiker, Dr. Johnson, and Professors Walther, Akers, and Cruickshanks.

Twenty-six men received keys symbolic of Sigma Tau membership. They are: Charles Myers, Kenneth Bennett, Albert Tinkelenberg, John Geist, John McCubbin, Arthur Glenn, Jack Hamilton, Bedford Robertson, Louis DeVico, Victor Reddle, James Roamer, Elmer Landers, Lawrence Proctor, Milton Ammon, Richard Bartik, Robert Buckley, William Sutherland, Francis Coffey, Andrew Orebaugh, Kenneth Woodward, Phillip Watkins, Arthur C. Machlin, Joseph Masiello, Henry Hutto, Louis Landsman, and Herman Schkolnich. The presentation of keys to these men was made by Prof. Milton K. Akers, faculty advisor of Sigma Tau.

The banquet was presided over by Ervin Liljegren, President of the GWU chapter of Sigma Tau. As is the customary procedure at banquets of this nature, the honored guests in attendance are asked to make short speeches. Our distinguished faculty members responded very graciously. In the main, their talks could not be classed as "scholastically" beneficial to young engineers and for want of a better classification, it may be said their remarks dealt with "what every young engineer should know about society in general and women in particular." The sources of such information were not divulged in most instances.

It is always a memorable occasion when new members are initiated into an honorary fraternity and it was with great pleasure that Sigma Tau welcomed the twenty-six new men.

(*Continued from page 3*)

the School of Engineering on their fine work in erecting the Christmas tree. At the conclusion of Dean Doyle's remarks, the throng which had gathered to witness the ceremonies joined forces with the glee club for the singing of several carols. The program was then closed by Larry Brown. The entire ceremony was wire recorded by Radio Station WCFM for a broadcast presentation at a later date.

The Christmas tree was lighted from dusk to 11 P.M. each evening. It stood as the result of the initiative and ability displayed by the engineering students of the George Washington University.

The Balloons Are Up

By W. G. KISTLER

Over the week-end of November 5-7, the eastern seaboard was thrown into its latest war scare. What had appeared to be a return of the Flying Saucers was later identified as a 'free' (it cost the Engineers Council $0.70), meteorological balloon, and its "ring of fire" was nothing more than the slogan, "Flato for Sr. class Sect." stenciled in red paint.

In case you're still wondering, all this came about at the last election of class officers. Thru the use of two lettered balloons, which made the Yard look like London and its barrage balloons, an effort was made to stimulate the engineering vote to put a man of our choice in as a class officer. Although the final count still found us 50 votes behind the opposition, the results were encouraging. So much so, that at first reports the other party was visibly worried and proceeded to cut our advertising campaign in half by releasing one helium filled balloon, property of the Engineers Council.

The student council has recognized the balloons as the symbol of the engineers, and whenever possible all engineering functions will be hailed on the campus by their appearance. The latest use of our one remaining balloon was in giving a season's greetings to all from the engineers, and in advertising the 10th annual Christmas tree lighting ceremony held behind Lisner Library on December 13.

From now on when you hear the slogan, "The balloons are up," you'll know that something is in the wind for engineers.

IRE

The GW Student Branch of the Institute of Radio Engineers hereby gives belated notice of welcome to its able Faculty Adviser, Mr. William S. Carley, who, with great disregard for his own peace of mind, assumed the duties of that post last last summer. Welcome also are a number of new members of the national organization, including Norton Ansher, Collins Arsem, Jay R. Beatty, Robert F. Biloon, Frank L. Carau, Jr., Samuel J. Collins, Milton E. Compton, Jr., John P. Conner, Arthur J. Glenn, Robert E. Huffman, Herman J. Katzman, Charles F. Luce, Edgar D. Morgan, James C. Moseley, Jr., Elwood H. Mullins, James A. Murray, Jr., Saul Pincus, William L. Reed, George W. Reynolds, Michael Saba, Saul Schach, Justin C. Schaffert, John H. Shepherd, Jr., Harold E. Thompson, Elmer G. Via, Jr., Gerald L. Warner, Elias Weinberger, and several others.

The officers of the GW branch, elected last spring, are: Reid D. Mayo, chairman; Bill Whittemore, vice chairman; Bernard Trotter, secretary; and Matt Flato, treasurer.

A brief glance at the activities of the past year brings to light the annual picnic held last June, at Great Falls, Virginia, which features, in conformance with obscure custom, a picnic lunch, as well as refreshments which those who attended have discreetly declined to identify. The revelers were quick to point out, however, that some were successfully restrained from trying to shoot the rapids.

With the fall term, the regular business meetings and program events were resumed, sparked by the Engineers' Mixer in October. These sessions are held on the first Wednesday night of each month, with the short business meeting immediately following the program. As to the program material itself, we have been very fortunate in receiving the cooperation of noted authorities in various fields related to the radio and electrical arts, and who have presented informative talks of interest not only to the specialist and the advanced student, but to beginners as well. The future outlook is equally promising; for example, on the next meeting night, January 6, 1949, the IRE student branch will be addressed by Dr. J. Howard Dellinger, speaking on "Radio Wave Propagations." Dr. Dellinger received the B.A. degree from the George Washington University in 1908, the Ph.D. from Princeton University in 1913, and the Doctor of Science from the G.W.U. in 1932. He recently retired as chief of the Central Radio Propagations Laboratory of the National Bureau of Standards.

He has engaged in and directed much of the Bureau's research and development work for the

Electronic Romance

By M. A. JOLSON

One day Eddy Current and Milly Ampere went riding on Eddy's kilocycle. From the saturated city conductors they passed around the hysteresis loops and out into the magnetic fields. Out where the flux was not so dense, they were just running out of voltage when they came to the wheatstone bridge. Looking down to the banks of the electronic stream, they saw discharge currents flowing into the junction, so they hastened thence to recooperate with a little feedback.

Laying there in the warming radiations, Eddy could hardly help but notice Milly's characteristic curves. What first derivatives! Eddy began to feel as though he were in a high voltage line. There was an intense internal thermal agitation and he began to pulsate at a verv high frequency—obviously his control elctrode was not functioning properly.

The force of attraction was too much and before Eddy could resistor he and Milly were tightly coupled and soon tuned to resonance. This could have lead to a chain of reactions, but alas and alack, this little story ends here—someone blew a fuse.

past forty years. During the same period he has been Chief Engineer of the Federal Radio Commission (1928-29) and president of the Institute of Radio Engineers (1925). He has also been active in several other scientific societies and written over 200 scientific and technical papers on radio and allied arts.

Both business meeting and program are open to all who may be interested. Your attendance will afford an opportunity to find out about the organization and its activities, and to hear first-hand authoritative discussions of research and development work, frequently before such information is available through any other source.

Plans for expansion of the membership roster are going forward rapidly; as the group becomes larger, it will be feasible to act on some of the many proposals for additional activities. Subject to further investigation and discussion, it has been suggested, among other things, that workshop facilities, with informal instruction for beginners, be provided, and that code practice and other aids be sponsored for those interested in obtaining amateur licenses. Field trips to nearby installations and facilities are planned; definitely in the works is a field trip to NBC television station WNBW at the Wardman Park Hotel.

The possibilities are by no means exhausted. The GW branch of the IRE is not only a going concern, but a growing one. Your participation offers many advantages both to the organization and to you. And—incidentally—we have fun!

ASME

Mr. Heurich's Brewery, always dear to the hearts of the engineers, became more so on the evening of November 10 when about three hundred engineers and students held a party there. Washington engineering students were guests of the Washington chapter of the American Society of Mechanical Engineers, and the students represented Catholic University, Maryland University, and George Washington University.

A prize of $5.00 was awarded for attendance; this was won by C. U. with ninety in attendance. George Washington was represented by sixty and Maryland by twenty-one students.

One of the primary attractions of the evening was an unlimited flow of beer and sandwiches. What more need a program have.

After brief—very brief—introductions and comments, the party was entertained by a Baltimore group whose mistress of ceremonies kept the ball rolling freely between acts. (Sorry, we can't quote her.) The acts included tap dancers, a hula-dancer, an acrobatic dancer, and a juggler and magician.

Spontaneous urges to sing were chord-inated and the party enlivened for half an hour more.

Little technical engineering was accomplished —little had been anticipated—but Keith Allen did volunteer to complete the construction of the new Student Union by himself.

AIEE-IRE

At a joint meeting on Wednesday, 1 Dec. 1948, the AIEE and the IRE heard Mr. Gustav Shapiro, Head of Miniaturization Division, and Mr. Robert Henry, Head of Printed Circuits Division, both from the Bureau of Standards, speak on the timely subject of "Printed Circuits and Miniaturization." Mr. Shapiro, speaking on miniaturization, had a collection of electronic components which had been reduced in physical size to a small fraction of their more common size. He demonstrated the new mercury battery which, though having ample capacity to supply power to the ordinary flash-light bulb, is however, small enough to get lost if placed in one's pocket. Mr. Shapiro emphasized that there was a practical limit to which electronic components could be reduced in size and that radio circuits ultimately depended on printed circuits for further miniaturization. Mr. Henry spoke on the development of printed circuits and their applications. Two transmitters made of printed circuits, one of which was of the wrist-watch variety, were discussed and demonstrated by actual operation. Both speakers joined in the discussion period which followed the talks and in conclusion presented miniature radio tubes as souvenirs to the audience.

ELECTRO-MAGNETIC FLUID CLUTCH

By P. ASANO

I am sure all of you have heard or read about the new Electro-Magnetic Fluid Clutch. This new clutch has had a lot of publicity in the newspapers and magazines. It was developed recently by Jacob Rabinow, a Bureau of Standards Scientist, in connection with research into the application of magnetic fields to control frictional forces between solids and certain types of fluid media. Mr. Rabinow assigned the patent rights to the Government.

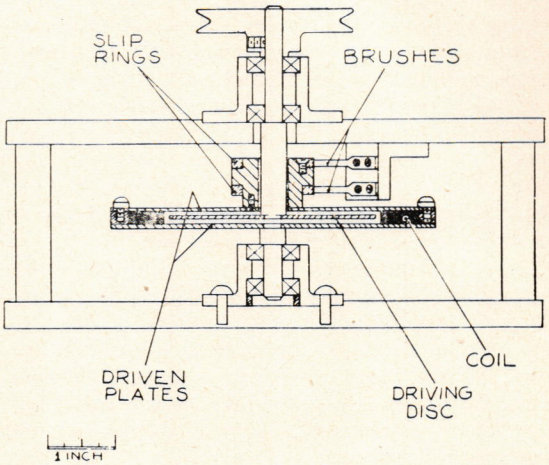
The Electro-Magnet Fluid clutch operates on a very simple principle. When the space between two parallel plates is filled with finely divided iron particles and a magnetic field is established between the plates, the magnetic particles bind the plates together against any movement parallel to their surfaces. To prevent packing of the iron particles and to provide lubrication and smooth operation, the iron particles are mixed with oil. When this oil-iron mixture is acted upon by a magnetic field, the mixture seems to solidify. The magnetic field can be controlled by an electric current and in this way the binding force can be controlled over a wide range.

This principle is applied to a clutch, called the Electro-Magnetic Fluid Clutch, and it has many advantages over other existing types. The diagram represents one of several models developed by the Bureau of Standards. Because this clutch has no axially moving parts, it is very simple to build and consists essentially of a driving and driven member which do not change relative position, except in rotation. All moving surfaces are lubricated and wear is practically nonexistent. Even if there is some wear, it would only add to the oil-iron powder mixture.

One of the unusual features of this clutch is that the value of static friction does not differ appreciably from that of kinetic friction. Therefore no change in torque occurs at the moment of initiation of slip. This is one reason why the operation of the clutch is so smooth. In ordinary friction clutches, differences in static and kinetic friction is the main reason for chattering.

The clutch is very easy to control and requires only a small amount of electrical power. The control is extremely smooth from the minimum which is dependent upon the viscous drag of the oil to the maximum which is dependent upon the saturation of the iron.

The relation between exciting current and torque is practically linear through zero. In most electro-magnetic devices the torque is proportional to the square of the current; this makes control difficult. Torque in this new clutch is



proportional to control current through a wide range of torque values.

Unlike the fluid drives used in some of the automobiles, this clutch is not a speed sensitive device. If the load is below the slipping torque of the clutch, no slippage occurs and the efficiency of the clutch is 100%. In one experiment with a flat plate clutch torque was measured by a spring scale attached to periphery of the plate by means of a thin cable. The clutch was driven by means of an electric motor and it was found that the pointer on the scale remained completely steady for a wide variation in speed for a given value of control current.

Since the speed of response is of greatest importance tests were made and it was found in most clutches that the time of torque rise and decay was 1/30 of a second and in some cases the time was 1/60 of a second.

A great deal of the performance characteristics depend upon design. Design principles of the magnetic circuit are no different from those of other magnetic circuits with the exception that the permeability of the mixture increases. For instance, a mixture of cabonyl iron and oil has a permeability of approximately eight times that of air. This means that the width of the gap for a mixture can be increased eight times the width of the gap for air. This of course is a big advantage. Permeability of a mixture can be controlled by the amount and size of the iron particles.

The effect of viscous drag is also dependent upon the choice of the mixture and the width of the air gap. In one of the experimental clutches made, the drag was approximately 1.0 lb.-in. at a 1000 rpm and varied linearly with speed. There are many ways to avoid the effects of viscous drag

FOOTNOTES

By LLOYD HARKER

You've all probably read about the man who couldn't see amoeba under a microscope. Everyone else could, and God knows he tried, but he just couldn't see that amoeba. I'm having the same basic trouble with the sliderule.[1] It all started one day when I was standing in the engineers' exclusive three square feet of the Student Club and listening to two fellow students.

"Gee, I wish I could have used my slide rule," one of them was saying. "The problem was, if ten million atoms split, the halves split twice, and the total send one-eighth of their energy toward the moon at six ergs per centipede, what's the price of an electron in Lower Slobovia? Could have got it in a second on 'old Betsy.' But no slide rules allowed. Ah well." They slipped some more Club black grog, then turned and looked me over.[2]

"Where's your slide rule, mate?" they chanted in unison.

I knew I couldn't tell them I didn't have one. I'd have been lost without a slide rule and they knew it. With a flash of inspiration I patted under my left armpit with my left hand,[3] and grinned slyly. "Got it right here. Keeps it out of harm's way. Quick on the draw, too."

They looked at me admiringly,[4] turned away and whispered to each other, and then in beautiful harmony chanted in my direction, "Mac, how they gonna' tell you are an engineer if your slide rule don't show?" I was ready. "Look," I said. I pointed to a small patch of whiskers grown into the shape of a train engine running into my ear. "Engine-into-ear." "Engineer, get it?" It wowed them, and with a last flung sneer, I turned and marched triumphantly away, stumbling over one of the many spittoons as I did.[5]

After this episode I knew I'd have to get a slide rule and learn to use it. So I got one and went to class. I want to say right now that I don't think it is the instructor's fault. I mean, when he told them to pick a number on the scale, slide the silder to another number, and follow through a right cross to the breadb . . . whoa! Anyway, everyone elses head nodded, and a smile broke over everyone elses face. But . . . I don't know, they go so fast. Like those Navy schools used to be—a guy bent over to tie his shoe and missed a course in algebra.

The first day the instructor said, "The index is at the end of the stick." While I was still hunting for the index, he took the class through multiplication, division, square root, cube root, sine and cosine, and was well into beating the roullette wheel.

I haven't given up though. At least I have a slide rule, and it's coming in handy every day. It makes a good backscratcher and is good for lots of other little things like that. You'd be surprised.[6]

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[1] Something developed by George Case?

[2] "Ugh," said they, and I didn't know one word could carry so much description.

[3] I'm double jointed clear up my left side, but enough about family traits.

[4] I didn't blame them. I was wriggling my left ear now—top half only.

[5] Did you hear the one about the three ineibriated men who stumbled into a joint one night. The first sat at the bar and passed out, the second propped himself against the jukebox, and the third fell face down in a spittoon. The barkeep nodded at the one still standing and said, "What will you have?" Indicating the man at the bar, he said, "He wants a scotch and soda, give me a shot," and pointing to the one in the spittoon, "better not give him anything. He's driving."

[6] Some say the slide rule will replace the zither in American households.

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as mechanical separation of the clutch plates when idling. Residual magnetism causes some torque but this can be overcome by reversing the switches or by using iron having a thin hysteresis loop. Where low inertia is required of the driven member, as in high speed servo work, the exciting coil can be made a part of the driving member. A thin plate can then be used to pick up the torque. Experiments were made with mesh wire and perforated magnetic materials with favorable results. Non magnetic driven plates can be used with certain designs.

As you can imagine, the possibilities for the use of such clutches are unlimited. Research is now only in the early stages and probably a great deal more of the possibilities of the electro-magnetic fluid clutch is still yet to come. Of course the most obvious use of this clutch is in automobiles. Advantages over the friction type clutches with its gear trains and its unsatisfactory poreation are tremendous. However, because of its ease of control, high efficiency, smooth operation, long life, and simplicity of construction, the electro-magnetic fluid clutch is especially adaptable to use in servo-mechanisms, and it in this field that it is expected to have its main applications. Another broad field of application is in constant torque and over-load devices where the clutch need not be de-energized.

(*Continued from page 3*)

writer cannot be too heavily condemned, it still would make the course possible.) The system subtly assumed throughout the paper seems inherently to best serve both student and instructor in a course such as this. The grade for the course could be exactly determined from credits accrued during the semester so that the student and the instructor are always aware of the student's progress and standing. Good or poor work receives its reward at the discretion of the instructor on each project, while choice of "snaps" or simple projects is discouraged by the low possible credits for such a project. A slight modification would be for the instructor to simply grade each project alone with no "credit" as such in mind other than exercise of his own judgment. In this latter case the system would be very similar to that used in most of the present laboratory courses, the difference being in freedom in choice of project and in individual work.

Grading on projects should be based first on the written report, considering the student's ability to formulate a good design and make the pertinent calculations towards a particular goal in performance. A measure of this will be found in the critical analysis of the actual performance data for the apparatus. These items may be compared to the "Theory" and "Discussion of Results" in the power laboratory reports, though on a more comprehensive basis. The second point to consider in project grading is the actual project itself, i.e., the layout, wiring, and assembly. Grading of this portion should be done with careful consideration of the student's capabilities and progress rather than by comparative standards with other students. The reason for emphasis on this point is that each project is essentially separate from the others in complexity and techniques required, aside from the initial capabiltiies of various students, so that reduction to a common denominator would be quite unfair. A third consideration may be made as to the time required for the project, taking into account the nature of the project. This may or may not be deemed necessary and certainly, if it is considered, should not bear too grately on the grade if the time required is at all reasonable. Time may be considered a negative factor, that is the project may have a deadline but no extra credit given for early work. This grading procedure incorporates no radical changes from the standard other than giving consideration to the actual material project as constructed by the student.

So that the student will enter the course fully able to undertake at least the simpler projects it is whole-heartedly recommended that prerequisites be established to include Physics 132, E.E. 107. at least, and preferably with concurrent registration or completion of E.E. 118, Physics 133, E.E. 111-112. With such for prerequisites it becomes automatically necessary to offer the course in the senior year in either term. To avoid the necessity of too many laboratory courses this course may be installed as elective with some other laboratory course offered at present.

The student should be encouraged at all times to work on his own but should still have full chance to receive the aid and guidance of the instructor. It should be reiterated at this point that each project should be started from scratch, each layout and design done by the student, all mechanical work and assembly should be done by the student.

There should be no need for a specific text, in fact due to the diversity of possible projects a text would be difficult to decide upon. One possible exception would be the "Radiotron Designer's Handbook" by R.C.A., however at present this is one of the texts for one of the prerequisite courses (Physics 132) and as such need not be redesignated.

In retrospect it is clear that this course will provide an approach to Communications Engineering that is more practical than any in the present curriculum. It gives the student an opportunity to do original, material work on his own, a chance to try out what he has learned in other courses, a chance to become acquainted with the design and construction techniques of his profession.

ASCE

The ASCE's began their inspection trip program this year on the thirteenth of November by a well-planned tour of the Whitehurst Memorial Parkway, commonly called the "K Street Overpass." A large part of the success of the trip was due to the willingness and capability of Messrs. Alexander and Repass, of the contracting firm of the same name, and Dean Walther, in answering the many questions put forth by society members. Among the highlights of the trip were an examination of the blueprints of the job, an analysis of unusual problems already encountered, and the inspection of a pump-crete machine used to pump concrete for the slab up from street level thirty feet below.

At the last regular meeting of the society a record turnout was privileged to hear Capt. O. S. Reading, U. S. Coast and Geodetic Survey's internationally known expert on photogrammetry, speak on the importance of this science in engineering. This enlightening talk was supplemented by a variety of slides, principally showing views of the elaborate machinery used in photogrammetry.

(*Continued from page 1*)

internal combustion engine, and torsional vibration dampers.

Large torsional viscous friction dampers, manufactured for use on large Diesel engine shafts were described. Properties of the new silicone fluids that are required for damper design were given in addition to the constitutional details and its method of manufacture. Test results obtained were compared with the theoretical calculations based on the theory of the torsional viscous friction damper as applied to multimass systems.

For the study of combustion phenomena in the internal combustion engine, construction of a temperature-entrapy chart for air was presented, and related to the solution of combustion problems.

It was shown also that the convertible portion of the exhaust energy from the internal combustion engine may be utilized by an exhaust turbine. This energy was indicated as theoretically equal to the tail triangle between the extended isentrapic line and the atmosphere line to which the exhaust finally expands. Nomographs for single solution of the energy available in the exhaust were derived.

A very interesting symposium was presented under the auspices of the Railroad and Industrial Instruments and Regulators Division. The symposium discussed non-destructive testing of parts and assemblies from rolling stock and motive power. The basic techniques used in non-destructive testing instruments consist in: 1. Directing pulses of ultrasonic energy into the material under test and determining the location and extent of flows by detecting the sound energy reflected to the source or; 2. Transmitting ultrasonic energy through the material and measuring the relative reduction in the sound transmitted through defective areas.

The 69th Annual Dinner of the ASME was held on Dec. 1st in the ballroom of the Hotel Pennsylvania. It was so well attended that tables overflowed the main ballroom into auxiliary banquet rooms. All witnessed the impressive ceremonies during which the Society conferred honors and awards on distinguished engineers, and paid tribute to the leadership of its senior members and officers.

President E. G. Bailey read the names of thirteen members who now join the Fifty-Year Members of ASME, a distinction marked with a special medal. These members are: George W. Bacon, Robert E. Hall, Adalbert Harding, Dean E. E. Hitchcock, David T. Jones, George H. Merrill, Charles S. Matt, Dr. Fritz Neuhaus, Alexander M. Orr, William E. Reed, Harold A. Richmond, Alfred H. Stevens, and George F. Waddell.

The following honors and awards were conferred: ASME Medal to Frederick G. Keyes for his many fundamental contributions to the advancement of mechanical engineering; Halley Medal to Edwin H. Land for his great and unique work in polarized light and optics; John Fritz Medal to Theodore Van Karman for his many applications of mathematical and physical theory to the sound solution of engineering problems; Worcester Reed Warner Medal to Edward S. Cole for contributions to the measurement of the flow of water; Junior Award to Hunt Davis for his paper "A Method of Correlating Axial Flow Compressor Cascade Data"; The Pi Tau Sigma Gold Medal Award to Walter G. Vincenti for outstanding achievement in aerodynamic research; Charles T. Main Award to Earle D. Stewart for his paper, "The Relation of Invention to Engineering"; Postgraduate Student Award to Thomas T. Dinsmore for his paper "An Experimental Investigation of Stresses in Eyebars"; Undergraduate Student Award to Leroy W. Ledgerwood for his paper, "Hired Technicians of Professional Engineers."

After the completion of the awards and honors, Mr. E. G. Bailey, retiring president of ASME gave the traditional Presidential Address. The keynote was "Engineering Opportunities in Industry." President Bailey outlined the development of engineering from the time man first utilized fire, wind and water. He traced the maturing of modern industry and indicated its vast potential not yet explored. He stressed the importance of management's increasing responsibility as opportunities are expanded by engineering research.

The traditional Members and Students Luncheon held on Thursday, Dec. 2nd, was most successful. More than 400 student representatives and members from over 123 engineering schools sat down together to honor young engineers on the Society's 1948 Honor List, but mostly to enjoy a good meal, exchange ideas, and to know more of each other.

Retiring President Bailey gave a short talk to the gathering. He emphasized the necessity for the young graduate engineer to sieze the initiative and make his opportunities in the field of engineering. Noteworthy was his mention that industry had a responsibility to the new generation of engineers. This was important not only for developement of the young engineer in technical knowledge but also in the broadening of his ideas in the field of human relations.

Following his remarks, Mr. Bailey introduced President-Elect for 1949, Mr. James M. Todd, Fellow ASME. Mr. Todd then spoke outlining the problems of the Junior Engineers. He said

(*Continued on page 12*)

Then there was the fellow called "Opium." He was the product of a wild poppy.

Asked to define a wolf, a wise senior said, "A member of the male species who devotes the best leers of his life to women."

There was a young lady from Lynn
Who thought that to love was sin,
But when she wos tight
It seemed quite all right
So everyone filled her with gin.

She: "Where did you learn to kiss like that?"
He: "I eat spaghetti."

From the chemistry department comes the word that the first alcohol was distilled in Arabia —which might partially explain those nights.

A bathing suit is like a barbed wire fence because it protects the property without obstructing the view.

The origin of the saying, "Oh, yeah," has been attributed to an unbelieving bridegroom who upon hearing his bride say, "Now I lay me down to sleep," said to himself: "Oh, yeah!"

For G.W.U. students who want to keep abreast of the great strides science is taking in the electronics and sound field, the Lit school is offering a non-technical course in radio called Creative Listening 1. No prerequisites.

(*Continued from page 11*

that since the average age of the engineering graduates for the past two years has been between 25 and 30 years of age, it is contemplated that the so-called Junior Engineer designation might be abolished.

Mr. Todd's talk was concluded by a hope for increased participation by the young engineers in the affairs of the Society and his continued interest to further the Society's work on behalf of young engineers.

The Annual Meeting continued for the remainder of the week. However, the close of the Student and Members Luncheon terminated our visit to an interesting and enriching experience.

As Professor Liddifree says in Mechanics "Every couple has its moment."

There is a certain gentleman I know wandering about this campus who always plans ahead. I understand he never makes commitments to the fair sex without reservations.

Patient in hospital in response to knock on door: "Who goes there, friend or enema?"

During the time I have been at this institution, I have noticed that the professor who comes in late is rare; in fact, he is in a class by himself.

She reached above her dimpled knee
Into her rolled-down stocking,
And there she found her roll of bills.
Ah me, 'twas sweetly shocking.
"Why don't you keep them in a bank?"
Inquired a nosey pryer.
"The principal is the same," she said,
"But the interest here is higher."

(*Continued from page 1*)

to a definite act by the nature of its design. The printing mechanism inevitably records what it receives without using any judgment factor in the process. However, unless the transmitted signal is received with such intensity and character as to be the controlling signal at the receiving end, errors will result. Therefore, the signal-to-noise ratio for radioteletype operation must be greater than that required for manual or semi-automatic operation. It is possible for a radio operator using head-phones to copy signals even during a period of extensive atmospheric interference. A radio-teletype circuit could not function during such periods. To balance and/or partially reduce the interference to normal operation of a radio-teletype circuit, many improvements were made which will be discussed later in the report. On the credit side of the ledger, there are three main advantages of radioteletype operation. There is a great reduction in human error and fatigue, increased speed in the handling of messages, and decreased cost of operation.

On the receiving end of the radio teletype circuit, two main means of improving signal reception were put into operation. Directional antennae were put into use so as to secure maxi-

mum reception of energy from the transmitting point. The Navy used rhombic antennae quite successfully on radioteletype circuits. In conjunction with these directional antennae, space diversity reception is employed. The theory of space diversity reception is simply as follows. It is well established that radio fading is caused by cancellation of the signal impulses at the receiving antenna. A radio frequency wave from the transmitter may travel multiple paths before arriving at the receiving antenna. The conflicting time elements developed by the wave in traveling these different paths may result in the signal arriving at the receiving antenna in opposing phase. This phase opposition causes cancellation (fading) at the receiving antenna. The space diversity system of reception is based on the fact that a high-frequency signal such as is used for long distance communication rarely fades simultaneously at two different points separated by a distance as small as several wave lengths. Therefore, by spacing two antennae approximately 1000 feet apart and coupling each antenna into a separate receiver, sufficient signal energy will always be received at one of the antennae to give satisfactory reception in its coupled receiver. It has been shown by actual circuit operation that for 240-word-per-minute transmission of intelligence, the differences in the path lengths of the signal does not cause distortion to the extent that teletype printing is impossible. In this space diversity system of reception, the automatic volume control is common to both receivers so that when the signal fades in one of the receivers, its noise level is held down to a very low value. This is a result of the AVG produced by the stronger signal in the other receiver which effectively cuts off the audio output of the receiver operating on a fading signal.

The radioteletype circuit also makes use of directional antennae at the transmitting end of the circuit. No simple antenna, with the possible exception of a single vertical element, radiates equally well in all directions. All horizontal antennae have directional characteristics. The directional characteristics of transmitting antennae are important, especially in point-to-point communication, because only those waves radiated in certain directions from the transmitter will reach a particular receiving point, while all energy radiated in other directions is wasted as far as transmission to the receiving point is concerned. By concentrating the radiated power in a particular direction much less transmitter power is required to produce a satisfactory signal at the designated receiver than would be the case if the energy were radiated in all directions. An analogy to directional transmission of radio frequency energy is the automobile headlight. In the latter case, the transmission is that of light energy and in the headlight, the light is directed toward the road ahead where illumination is required rather than out in all directions.

For a number of reasons including transmission stability, considerable advantage was gained by employing a two-frequency method of transmission in which one frequency is employed for the marking signal and another frequency for the spacing signal. The terms marking and spacing refer to the positions assumed by relay mechanisms in setting up a character of the alphabet in accordance with the Baudot code. Each character in the alphabet along with symbols and numbers have their own combination of mark and space pulses. Tapes with the appropriate intelligence are sent from a small channel transmitter station. The keying of the main transmitter by remote control is essential in most cases since the transmitter station must have large area and thus a city location would be prohibitive in cost and in most cases would violate city zoning regulations. The term applied to this two-frequency method of transmission is Frequency-shift keying. The marking frequency is separated from the spacing frequency by 850 cycles, the former being 425 cycles above the assigned carrier frequency and the latter 425 cycles below. For example, if your assigned carrier frequency is 14150 Kcs, the marking frequency would be 14150.425 Kcs and the spacing frequency would be 14149.575 Kcs. In actual circuit operation, the assigned carrier frequency is never heard on the air. The signals sent down from the communications office by land-line is fed into a frequency-shift keyer. The frequency-shift keyer is a balanced modulator unit and the frequency produced depends upon whether the signaling current flows one way or the other through the control circuit. This signaling current is the result of the punching of the tape at the communications office channel transmitter. In the Baudot code, all characters are set up on a five pulse system. The character "r" for example, has the following set-up; pulse one is spacing, pulse two is marking, pulse three is spacing, pulse four is marking, and pulse five is spacing. Current pulses would be sent down the line in this order; space, mark, space, mark, and space. The corresponding radio frequencies would then be sent out over the air by the frequency-shift keyer.

High speed radioteletype circuits in operation during the war with the transmitting and receiving refinements mentioned in this report had very low outage time and very high message output for long distance communication networks where the transmitting and receiving ends were as much as 6000 miles apart. The military requirements of a communications circuit, that of high speed and reliability, were handily met by radioteletype operation.

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